



FAA-E-2666  
November 29, 1976

# DEPARTMENT OF TRANSPORTATION

## FEDERAL AVIATION ADMINISTRATION

### SPECIFICATION

#### MICROPHONE, HAND-HELD

#### 1.0 SCOPE

1.1 Scope.- The equipment specified herein is a hand-held microphone assembly designed for use as an FAA standard and used with communication systems at air traffic control facilities. The assembly consists of a dynamic microphone and amplifier mounted in a high impact plastic case with push-to-talk switch, and a connecting retractile cord with plug. The microphone assembly is designed to suppress undesired background noises and voices.

#### 2. APPLICABLE DOCUMENTS

2.1 Documents.- The following FAA and military documents of the issues in effect on the date of invitation for bid, or request for proposals, form a part of this specification to the extent specified herein.

##### 2.1.1 FAA document.-

FAA-G-2100/1    Electronic Equipment, General Requirements;  
Part I Basic Requirements for all Equipments

FAA-STD-013    Quality Control Program Requirements

##### 2.1.2 Military specification.-

MIL-M-26542    (USAF) - Microphone, dynamic M-87/AIC

MIL-E-17555      Electronic and Electrical Equipment and  
Associated Repair Parts, Preparation for  
Delivery of

MIL-STD-756      Military Standard, Reliability Prediction

(Copies of this specification and applicable FAA and Military documents may be obtained from the Federal Aviation Administration, Washington, D.C., 20591, ATTENTION: Contracting Officer. Requests should fully identify material desired, i.e., specification numbers, dates, amendment numbers, complete drawing numbers; also, requests should state the contract involved or other use to be made of the requested material.)

### 3. REQUIREMENTS

3.1 Equipment to be furnished by the contractor.- Each hand-held microphone assembly furnished by the contractor shall be complete and in accordance with all requirements herein specified. The contractor shall furnish microphones in accordance with quantities specified in the contract schedule and the options listed below, when ordered in the contract schedule.

Option 1: Retractable cord length (3.5.3.4)

- a. 3 meters extended
- b. 5 meters extended
- c. 8 meters extended

Option 2: Microphone assembly test set (3.8)

Option 3: Technical information (3.9)

Option 4: Prototype qualification (4.7)

### 3.2 Definitions

3.2.1 Face.- The term "face" is defined as that area or side of the microphone case which is intended for the user's normal speech input. This is the close sound source field for the microphone element or transmitter diaphragm.

3.2.2 Sound pressure level or SPL.- The term "SPL" defines the sound pressure level expressed in dB above a reference level of  $2 \times 10^{-4}$  dynes/centimeter<sup>2</sup>. The reference level has a numerical value of 0dB SPL.

3.2.3 Sound source.- The microphone/amplifier sensitivity and associated noise cancelling performance requirements specified herein are defined as the SPL of close sound source and the distant sound source fields that the microphone element is subjected to when the equipment is mounted inside a plane wave tube equivalent to the anechoic chamber and when measurements are conducted using test procedures, which are defined in MIL-M-26542 (USAF).

3.2.4 Service conditions.- The term "service conditions" defines the environmental range of temperature and relative humidity which is +10°C to +50°C and 10% to 80% relative humidity, respectively.

3.2.5 Assembly.- The term "assembly" defines all of the components of the microphone element, amplifier, case, PTT switch, cord and plug in a complete configuration that meets performance requirements stated herein.

3.3 Specification FAA-G-2100.- The following paragraphs in FAA-G-2100/1 shall apply as stated below to the design, manufacture and test of the assembly.

FAA-G-2100, Part 1

1-3.2.2  
1-3.2.4  
1 3.2.12 to 1-3.2.13  
1-3.2.20

1-3.2.21 Modified Table

<u>Parameter</u>	<u>Standard Design Center Value</u>
ambient temperature	30°C
DC current	75 ma.

1-3.2.22 Modified Table

<u>Parameter</u>	<u>Tolerance</u>
Temperature	+10°C
DC current	+25 ma.

1-3.2.24  
1-3.4.1  
1-3.5.9.2.2  
1-3.8.4 to 1-3.8.5.5  
1-3.8.6.to 1-3.8.8  
1-3.14.3  
1-4 et. al. except 1-4.12

3.4 General configuration.- Each assembly furnished shall be a dynamic moving-coil, noise-cancelling microphone with a push-to-talk (PTT) switch and an amplifier mounted within the microphone case. A retractile cord shall connect to the amplifier and PTT switch using a 4-wire circuit. A six wire, type PJ-511 male plug (W.E. 425A or equivalent) shall be provided and connected to the other end of the cable. With the plug interfaced with external equipment, a DC current will be supplied to power the microphone amplifier via the tip circuits of the plug. The amplifier output shall be provided on the same tip circuits. The

microphone PTT circuit shall be a dry closure circuit and be connected to the ring circuits on the plug. The sleeve connections on the plug shall not be used. When the assembly is energized via external power applied to the tip circuits of the plug, the microphone element and amplifier shall be wired so as to enable voice transmission without depressing the PTT switch. The weight of the assembly with a 3 meter retractile cord (Option 1a) shall not exceed 453 grams.

3.5 Construction.- The microphone case shall be shaped as a flattened, inverted tear drop to permit being comfortably held in either the right or left hand. The point of the case shall be truncated for the cord assembly entrance. The case shall include provision for mating with a clip or bracket to permit mounting the microphone in a vertical position when not being used. A clip or bracket with mounting hardware shall be provided with each assembly.

3.5.1 Microphone case.- The case shall be constructed of black, high-impact plastic with polished exterior surfaces. When assembled, the case shall have all edges rounded with no sharp projections. Excluding the cable and the PTT switch actuator, the maximum dimensions of the case shall not exceed 7.0 cm. thick, 6.7 cm. at the widest point, and 10.1 cm. long. Openings in the case for noise cancellation shall be so located or arranged that the noise cancelling feature is not impaired by the operator's hand or fingers when held and operated in either the right or left hand. No flashing or burrs shall be permitted.

3.5.2 Noise cancellation.- The microphone shall be designed to permit the sound pressure field to strike both sides of the microphone element or diaphragm. Background noises and distant sound sources shall cancel out, while a close sound source shall be transmitted and appear at the amplifier output. Noise cancellation characteristics of the microphone/amplifier shall meet performance requirements stated herein.

3.5.3 PTT switch.- A non-locking, spring-return, leaf-type of switch with self-wiping contacts shall be provided as the PTT switch. It shall be mounted on the upper left quadrant of the face of the microphone case. The push button switch shall be shaped and integrated with the microphone case to permit frequent use over prolonged periods of time which results in minimal user discomfort.

3.5.3.1 Switch contacts.- The switch shall include one set of form "A" and one set of form "B" contacts. The form "A" contacts shall be bifurcated and close the external PTT circuit when the switch is depressed. The form "B" contacts shall be provided to permit shorting of the moving coil of the microphone output when the PTT switch is not activated. The assembly shall be designed for continuous operation without damage to any component with the microphone shorted. However, the form "B" contacts shall not be connected and will be reserved for future use by the Government.

3.5.3.2 Contact rating.- The form "A" and form "B" contacts shall be manufacturer-rated for a minimum of 200,000 failure free operations with a load of 0.5A at 48 V DC.

3.5.4 Retractable cord.- The extended length of the cord (3.1, Option 1) shall be at least 3, 5, or 8 meters, with the PJ-511 plug attached. Each microphone assembly shall be provided with the optional cord lengths and quantities as required by the contract schedule. The retractile ratio of the cord shall be at least 5 to 1. The cord shall have a 5 to 10 cm. straight section at each end. The outside diameter of the cord, when retracted, shall not exceed 2.54 cm. The cord shall withstand at least 100,000 flexes to 45° in each direction on a 7 mm. diameter mandrel without showing evidence of damage to the outside jacket or insulation of the individual conductors or an electrical discontinuity. The outer covering shall be white plastic and resistant to cutting and scuffing.

3.5.4.1 Conductor strain relief.- The cord shall be reinforced at the point of emergence from the microphone case by an elongated flexible guide or grommet which extends out of the case sufficiently to prevent greater flexing at this point than elsewhere in the cord length. The cord shall be anchored both inside the microphone case and at the male plug to provide strain relief for the conductors and prevent twisting of the cord.

3.5.4.2 Dielectric strength.- Insulation materials used in the cord shall limit leakage current to a maximum of 50 micro-amperes with 500 VDC applied to any two conductors.

3.5.5 Marking.- Each assembly shall include the following information, permanently marked on the back or side of the microphone case.

- a. Manufacturer's name
- b. Model No. or Part No.
- c. Serial Number of assembly

3.5.6 Serviceability.- As a minimum, the design and construction of the microphone assembly shall permit repair or replacement of the following items in the assembly.

- a. Microphone case
- b. PTT switch
- c. Cord
- d. Male plug
- e. Microphone element, noise cancelling
- f. Amplifier

3.6 Amplifier.- An amplifier shall be provided and enclosed within the microphone case to amplify microphone signals to the required output level (3.7.4.1). DC power for the amplifier shall be derived from a source external to the microphone assembly and provided to the amplifier interface via the tip circuits of the PJ-511 male plug. The amplifier shall be designed to operate from a non-polarized power source of 75 ma. nominal. The amplifier output impedance and load current requirements shall be designed to meet the requirements of 3.7.1 and 3.7.2. The computed reliability of the amplifier shall be at least 100,000 hours when computed using the reliability prediction procedures stated in MIL-STD-756.

3.7 Performance requirements.- The assembly shall be designed to meet the following performance requirements over the range of service conditions. Close and distant sound source fields shall be used in accordance with provisions stated in paragraph 4 herein and MIL-M-26542.

3.7.1 Output impedance and load current.- The assembly shall meet performance requirements when connected to an external effective load impedance (resistive) of 50 ohms  $\pm 40\%$  at  $1\text{KHz}$  and with the amplifier load current varied between 50 and 100 ma.

3.7.2 Polarity.- Performance of the assembly shall not be affected by the polarity of the DC power input.

3.7.3 Noise.- In an ambient noise field not greater than 40dB SPL, the noise output level of the assembly shall not exceed -45dBm.

3.7.4 Close sound source.- The following requirements for the assembly shall be met with a sound source field of 94dB SPL and at the specified frequencies applied to the face of the microphone.

3.7.4.1 Sensitivity.- At  $1000\text{ Hz}$ , the output level shall be -11dBm,  $\pm 4\text{dB}$ .

3.7.4.2 Frequency response.- With a constant sound source over the range of  $500\text{ Hz}$  to  $1500\text{ Hz}$ , the output level referenced to  $1\text{KHz}$  shall be within  $\pm 6\text{dB}$ , and shall be within  $\pm 10\text{dB}$  from  $1501\text{ Hz}$  to  $2500\text{ Hz}$ , referenced to  $1\text{KHz}$ .

3.7.4.3 Harmonic distortion.- With a constant sound source over the range of  $500\text{ Hz}$  to  $2500\text{ Hz}$ , the total harmonic distortion at the output shall not exceed 5%.

3.7.5 Distant sound source.- The following requirements for the assembly shall be met with a sound source field of 94dB SPL applied to the microphone input. An average output for the assembly shall be obtained by orienting the microphone face at  $0^\circ$ ,  $90^\circ$ ,  $180^\circ$ , and  $270^\circ$  with respect to sound source and taking the arithmetic average of the four output levels.

3.7.5.1 Noise cancelling sensitivity.- The average output level shall be at least 8dB less than the output level at 1000 Hz for the close sound sensitivity determined in paragraph 3.7.4.1.

3.7.5.2 Frequency response.- With a constant sound source over the range of 500 Hz to 1000 Hz applied to the microphone input, the average output level shall be at least 9dB less than the output level at the same frequency for the close sound frequency response as determined in paragraph 3.7.4.2.

3.7.6 Shock resistance.- The microphone and amplifier assembly shall withstand, for each of 3 mutually perpendicular planes, a test of three (3) free fall drops from a height of 1.2 meters on to hard surface such as asphalt tile floor without damage to the microphone case or switch assembly. In addition, the shock resulting from this test shall not increase the harmonic distortion measured in paragraph 3.7.4.3 by more than 5%.

3.8 Microphone assembly test set (option).- When specified in the contract schedule, a test set shall be provided for testing and repair of the microphone assembly. As a minimum, the test set shall be provided the functional capability of checking: a) the continuity of the PTT switch; b) the continuity of the retractile cord and plug; c) the microphone element sensitivity at 1KHz; and d) the amplifier. The test set is an optional item and quantities to be ordered will be specified in the contract schedule or purchase order.

3.9 Technical information (option).- When specified in the contract schedule, each assembly furnished shall be individually packaged and include the following technical data: wiring/schematic diagram; replaceable parts list with manufacturer's part numbers; and the manufacturer's name and address.

#### 4.0 QUALITY ASSURANCE PROVISIONS

4.1 Quality control.- The contractor shall be responsible for conducting all inspection and testing to assure product conformance with the requirements of the contract and this specification. A quality control program shall be provided and maintained that fulfills the requirements of FAA-G-2100/1, par. 4.1.

#### 4.2 Design qualification tests.-

4.2.1 Service conditions (option).- When specified in the contract schedule, the following tests shall be conducted over the range of service conditions:

<u>Test</u>	<u>Paragraph</u>
Sensitivity (close sound source)	3.7.4.1
Frequency response	3.7.4.2
Harmonic distortion	3.7.4.3

4.2.2 Normal conditions.- Under normal test conditions, the following tests shall be conducted:

<u>Test</u>	<u>Paragraph</u>
General configuration	3.4
Construction	3.5 through 3.5.6
Amplifier	3.6
Performance requirements	3.7 through 3.7.6
Microphone assembly test set	3.8

4.3 Production tests.- Under normal test conditions, the following tests shall be conducted:

<u>Test</u>	<u>Paragraph</u>
Construction (visual inspection)	3.5 through 3.5.6
Sensitivity (close sound source)	3.7.4.1
Frequency response	3.7.4.2
Harmonic distortion	3.7.4.3
Noise cancelling sensitivity	3.7.5.1
Frequency response (distant sound source)	3.7.5.2

4.4 Microphone close sound source.- During assembly tests, the microphone face shall be located 6.35 mm. from the centerline axis of the artificial voice for the sound source. The artificial voice shall be calibrated with a W.E. Model 640-AA microphone, or demonstrated equivalent.

4.5 Microphone distant sound source.- During noise-cancelling tests of the assembly, the microphone element shall be located 30.6 cm. from the centerline axis of the artificial voice for the sound source. The artificial voice shall be calibrated with a W.E. Model 640-AA microphone, or demonstrated equivalent.

4.6 Design qualification data.- Engineering data shall be submitted to the contracting officer, as required by the contract, to demonstrate compliance with requirements stated in the paragraphs listed below. The contractor has the option of demonstrating compliance by any of the following means: dynamic testing; by calculations based on design parameters, parts, and material specifications; or a combination of both testing and calculations.



<u>Requirement</u>	<u>Paragraph</u>
Failure-free operations	3.5.3.2
Retractable cord flexes	3.5.4
Amplifier reliability prediction	3.6

4.7 Prototype qualification (option).- When specified in the contract schedule, design qualification tests specified herein shall be conducted with a test sample consisting of at least five (5) prototype or production assemblies that are representative of the production equipment. Upon successful completion of these tests, there will be no further design qualification tests required for the production quantities on order. When specified in the contract schedule, the Government will require a field evaluation of these assemblies for a period of 60 days as part of the design qualification tests. The contractor may elect to manufacture additional assemblies prior to successful completion of prototype qualification tests; however, he does so wholly at his own risk.

## 5. PREPARATION FOR DELIVERY

5.1 Preservation, packaging and packing.- The preservation, packaging, and packing for each assembly shall be in accordance with MIL-E-17555, Level C.

5.2 Individual packing.- Where two or more units are packed in a common shipping container, each unit with its accessories shall be packed and marked so that it can be identified and reshipped individually without repacking.

## 6. NOTES

6.1 Note on information items.- The contents of this Section 6 are only for the information of the initiator of the procurement request and are not part of the requirements of this specification. They are not contract requirements nor binding on either the Government or the contractor. In order for these terms to become a part of the resulting contract, they must be specifically incorporated in the schedule of the contract. Any reliance placed by the contractor on the information in these subparagraphs is wholly at the contractor's own risk.

6.2 Options.- Inasmuch as this specification includes several optional arrangements, it will be necessary that the contract schedule specify the options to be exercised:

### Option 1: Retractable cord Length (3.5.4)

- a. 3 meters extended
- b. 5 meters extended
- c. 8 meters extended

Option 2: Microphone assembly test set (3.8)

Option 3: Technical information (3.9)

Test Option A: Service conditions (4.2.1)

Test Option B: Prototype qualification (4.7)

6.3 Intended use.- This hand-held microphone is intended to be used as an FAA standard, where required, at ARTCC's, TRACON's, Towers, and Flight Service Stations. The unit is plug-compatible with the 4-wire and 6-wire noise-cancelling headsets.